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Final Report
ONR Contract # N00014-87-K-0195
Studies of Coda Generation and Tomography
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Goals:

1. To understand the partitioning of elastic energy between a main pulse and subsequent coda, including the frequency dependent apparent attenuation of the main pulse and the statistics and decay characteristics of the coda.

2. To develop methods for inverting tomographic data when these data are incomplete, especially when the angular distribution of rays is uneven.

Results:

1. Coda Generation.

A. We examined about 600 observations of the oceanic seismic phases, Po and So, making careful measurements of the frequency-dependent properties of the coda. We showed that the coda properties varied systematically with both frequency and propagation distance. Of particular relevance to the study of seismic wave attenuation in the ocean basin is the fact that the Po coda decays only about half as fast as So coda. This result is consistent with the decay being caused by intrinsic attenuation in the mantle with quality factors of about Qp=1200, Qs=600 at 10 Hz. This result contradicts results of other authors, who argue that Qp<Qs in the oceanic lithosphere.

B. We performed a series of laboratory analog experiments to assess the effect of anisotropic scatterer distributions on apparent attenuation. The anisotropic scatterer distribution models preferentially aligned cracks in the ocean lithosphere. The apparent attenuation is found to vary with azimuth by a factor of two, being largest when the wave direction is parallel to the long axis of the scatterers. Mean wave velocities as a function of azimuth were also measured and compared with analytic theories.

2. Tomography

A. We have applied multispectral taper analysis to the problem of incomplete ray coverage in acoustic tomography. The fundamental idea is that lack of rays about a critical azimuth causes 'ringing' in the image, in much the same way that a boxcar truncation of a timeseries can cause 'ringing' in its spectral estimation. We have found a set of analytic orthogonal tapers that optimally improve the resolution of the image and which provides different compromises between completely removing the ringing but reducing image contrast to retaining the contrast but failing to remove the 'ringing'.

Publications:

Brandsdottir, B. and W. Menke, Measurements of coda buildup and decay rates of Western Pacific P, Po and So phases and their relevance to lithospheric scattering, J. Geophys. Res. 93, 10,541-10,559, 1988.

Dubendorff, B. and W. Menke, Physical modeling observations of wave velocity and apparent attenuation in isotropic and anisotropic two-phase media, in press in PAGEOPH, 1988.

Menke, W., Imaging the deep interior of the earth, Lamont Yearbook, 1987.

Menke, W., A. Lerner-Lam and I. Bjarnason, Two-dimensional multispectral tapers applied to incomplete tomographic reconstruction, to be submitted to J. Geophys. Res., 1988.

Theses:

Some of the tomography results is being developed for I. Bjarnason's PhD thesis.

Patents:

None.